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Remedial Planning Activities at Selected
Uncontrolled Hazardous Substance Disposal
Sites in the Zone of Regions IX and X

FINAL
100 PERCENT PIPELINE DESIGN SUBMITTAL
NEWMARK OU REMEDIAL DESIGN
NEWMARK GROUNDWATER CONTAMINATION
SUPERFUND SITE SOUTH PLANTS

U.S. Environmental Protection Agency
Contract No. 68-W9-0054

URS Greiner

Team Subcontractors:

Black & Veatch Special Projects Corp.
Shannon and Wilson, Inc.

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Prepared For:

Contract No. 68-W9-0054 / WA No. 54-37-9NJ5
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

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October 3, 1997

IDENTIFICATION FORM

Document Title:	**FINAL 100 PERCENT PIPELINE DESIGN SUBMITTAL NEWMARK OU REMEDIAL DESIGN NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE SOUTH PLANTS**
Site Location:	San Bernardino, California
Work Assignment No.:	53-37-9NJ5
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Plan Coverage:	This document constitutes the 100 Percent Pipeline Design Submittal for the Newmark Operable Unit Remedial Design, Newmark Groundwater Contamination Superfund Site Work Assignment (WA) in the U.S. Environmental Protection Agency's (EPA) Region IX under EPA Contract No. 68-W9-0054. These services are provided by URS Greiner, Inc. as prime contractor.

APPROVAL FORM

Prepared for: U.S. Environmental Protection Agency
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Approved by:

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APPENDICES

ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
A.C.	Asphaltic concrete
ASTM	American Society of Testing and Materials
B.F.	Blind flange
BFV	Butterfly valve
Caltrans	California Department of Transportation
City	City of San Bernardino
C.L.	Centerline
C.M.P.	Corrugated metal pipe
DHS-DDWEM	Department of Health Services - Division of Drinking Water and Environmental Management
DIA	Diameter
DIP	Ductile iron pipe
DTSC	Department of Toxic Substances Control
EA	Each
FCA	Flanged coupling adaptor
FLG	Flanged
fps	Feet per second
ft/1000 ft	Feet per thousand feet
G	Gas line
GB	Grade break
gpm	Gallons per minute
INV	Invert elevation
LF	Lineal feet
LS	Lump sum
MCL	Maximum contaminant level
MJ	Mechanical joint
NPL	National Priorities List
O.D.	Outside diameter
O&M	Operation and maintenance
OU	Operable Unit
PCE	Tetrachloroethene
PRV	Pressure Reducing Valve
psi	Pounds per square inch
Q	Flow
ROW	Right-of-way
S	Slope
SS	Sanitary sewer
SBCFCD	San Bernardino County Flood Control District
SBMWD	San Bernardino Municipal Water Department
T	Telephone line
TCE	Trichloroethene
URSG	URS Greiner, Inc.

ABBREVIATIONS AND ACRONYMS (Cont'd.)

USEPA	U.S. Environmental Protection Agency
WA	Work Assignment

1.0 INTRODUCTION

This 100 Percent Design Submittal presents design concepts, horizontal alignment drawings, and a technical specification outline developed for the pipeline system required to convey raw water from extraction wells to the groundwater treatment system at the South Plants, Newmark Operable Unit (OU), San Bernardino, California. The design is being prepared by URS Greiner, Inc. (URSG) under United States Environmental Protection Agency (USEPA) Contract No. 68-W9-0054/Work Assignment (WA) No. 54-37-9NJ5.

Groundwater in the Newmark OU has been impacted by chlorinated hydrocarbons above the maximum contaminant level (MCL) for drinking water (URSG 1993). Final well site locations have been determined and pipeline connection points have been incorporated into the plans.

The final pipeline route, profile design, and San Bernardino Municipal Water Department (SBMWD standards have been discussed with the SBMWD and incorporated into this design.

The design of the groundwater extraction and treatment systems is divided into two major design projects:

- Design of groundwater treatment systems. The design of the groundwater treatment systems was initiated before start of the transmission pipeline design because of the time required to obtain pipeline route survey information. A 100 percent plant design has been completed and submitted (URSG 1997a).

- Design of water transmission pipelines. This package covers the design of the water transmission pipeline for the South Plant. Exact location of the connection pipelines to the wells have been determined and finalized. Separate deliverables have been submitted for the groundwater treatment system design.

1.1 BACKGROUND

The California Department of Health Services now known as the Department of Toxic Substances Control (DTSC) discovered chlorinated solvents in municipal water-supply wells (municipal wells) within the north San Bernardino/Muscoy region of San Bernardino County during a 1980 groundwater investigation. Several investigations were conducted to locate the potential source(s) of contamination. On March 30, 1989, USEPA placed this region on the National Priorities List (NPL), thereby releasing federal funds for cleanup of the region, now identified as the Newmark Groundwater Contamination Superfund Site (site).

The principal contaminants identified in site investigations were trichloroethene (TCE) and tetrachloroethane (PCE). Reported concentrations of these contaminants exceed federal and California MCLs for drinking water in several municipal wells within the San Bernardino and Muscoy areas, including the Newmark Municipal Wellfield (Newmark Wellfield).

1.2 DESIGN OBJECTIVE

1.2.1 Intercept Plume Migration

The goal of this project is to intercept further migration of the Newmark groundwater contaminant plume. The proposed extraction well system, from which this pipeline will convey water to both the Waterman and 17th and Sierra Way Treatment Plants, will be located along 11th Street between Stoddard and Sepulveda Avenues. Determination of the preliminary well locations, number of wells, and pumping rates are contained in the report "Newmark Plume Front Extraction Well Technical Memorandum -- Newmark Operable Unit Remedial Design" (URSG 1995a).

1.2.2 Minimize Community Disruption

The construction of a buried pipeline in public streets through residential areas will necessarily cause some inconvenience for the local residents. To minimize these inconveniences the following requirements will be invoked: (1) construction activities will be limited to the hours of 7:00 a.m. to 7:00 p.m. except when extenuating circumstances require work be performed beyond these hours; (2) all roadway lanes will be made passable at the end of each day by backfilling or steel sheeting the trench; (3) if necessary, an entire street may close as construction progresses. Also, any proposed street closing will be coordinated with the City Public Works Department and properly posted prior to the street closing.

1.2.3 Agency and Water Purveyor Requirements

The pipeline has been designed in accordance with SBMWD standards and applicable Department of Health Services - Division of Drinking Water and Environmental Management (DHS-DDWEM) requirements. The pipeline design has been reviewed by DTSC and other agencies.

2.0 PIPELINE DESIGN

2.1 WATER TRANSMISSION PIPELINE ALIGNMENT

The following section is taken from the "Final Pipeline Route Study, South Plant, Task 6.2, Technical Memorandum No. 1 - Newmark Operable Unit Remedial Design" (Route Study) (URSG 1995b) and has been revised to reflect the design conditions set forth as a part of this Preliminary Design submittal. The entire "Final Pipeline Route Study" is provided in Appendix A.

The five extraction well sites are located on 11th Street between Stoddard Avenue and Sepulveda Avenue.

2.1.1 Selected Route

The proposed alignment of the transmission pipeline is as follows:

- Interconnect four of the five extraction well piping systems to one, common header along 11th Street. This will then connect to a 24-inch-diameter transmission pipeline. The remaining extraction well will discharge into a 16-inch-diameter transmission pipeline.

- The pipelines will be installed in the Mountain View Avenue right-of-way (ROW). The 24-inch diameter pipe will run north to Marshall Boulevard, then turn east to Leroy Street, then south to the west entrance of the Waterman treatment plant site. The 16-inch-diameter pipe will run north on Mountain View, then turn east on 17th Street to the existing 17th Street water treatment plant. An alternative route through 16th Street was evaluated during the 30 percent design phase. However, it was discovered that there are currently five parallel pipelines under 16th Street in the east-west direction: two sewers, two waterlines, and one gas line. It was therefore concluded that the 17th Street route was more feasible. There will be an inter-tie with a pressure reducing station between the Waterman plant supply pipeline and the 17th Street Plant supply pipeline to ensure an uninterrupted supply of raw water to the 17th Street Plant.

- Several methods to cross the Route 30 freeway were discussed in the Route Study. After several additional meetings and telephone conversations with the California Department of Transportation (Caltrans) staff and a review of the Mountain View Avenue Overcrossing record drawings, it was concluded that the most feasible alternative was to install the pipeline inside the east outside cell of the southbound bridge. Due to limited space, the pipeline diameter inside the cell will be decreased to 20 inches. The original plan, which had been discussed with Caltrans, was to hang the pipeline on the outside of the bridge. However, during a subsequent Caltrans meeting on June 15, 1995, Caltrans stated that hanging a pipeline outside bridge overcrossings would not be approved. During the June 15th meeting they suggested the east, outside cell of the northbound bridge. However, subsequent URSG investigations revealed that there is inadequate room for the pipeline casing and the east outside cell of the southbound bridge was selected.

2.1.2 Utility Impact

One important criterion in the selection of a pipeline route was the impact of the proposed pipeline to existing underground utilities, which, in this study, include water, sewer, and storm drains. Based on as-built drawings provided by the SBMWD, there is a 12-inch diameter waterline in Mountain View Avenue located on the southbound side of the street. The water main continues northward to Marshall Boulevard.

There are two existing gravity sewers in Mountain View Avenue. One of the sewers in Mountain View Avenue is on the southbound side of the street and the other is on or near the centerline of the street.

There are two major storm drains along the alignment: a 72-inch-diameter storm drain located under Mountain View Avenue near Marshall Boulevard, and a 60-inch-diameter storm drain also located in 21st Street as it crosses Mountain View Avenue.

Since Mountain View Avenue is a wide street with relatively few parallel pipelines, the impact to existing underground utilities by the selected pipeline route would be relatively minor.

2.2 PIPELINE SIZING

Design flow rates have been revised from the 60 percent submittal in the 100 percent design (1997b). The flow rates from each of the five extraction wells are as follows:

Well No. 1:	1,700 gallons per minute (gpm)
Well No. 2:	1,700 gpm
Well No. 3:	2,000 gpm
Well No. 4:	1,700 gpm
Well No. 5:	1,700 gpm

Three of the wells (numbers 2, 4, and 5) are designated to pump to the Waterman Plant via a single transmission pipeline. The combined nominal flow rate is therefore 5,100 gpm. The design flow rate including safety factor is 6,000 gpm. Well No. 1 is not included because it will normally pump to the Muscoy Treatment Plant. However, valving and piping is included so it could also pump to the Waterman Treatment Plant. The middle well, No. 3, will pump to the 17th Street plant. The nominal flow in this pipeline will be 2,000 gpm.

Two criteria were used in the selection of pipe diameter for the transmission pipeline:

1. Velocity. Optimal velocity of water flow is between 3 to 5 fps (feet per second).

2. Head Loss. Desired head loss is under 10 ft/1000 ft (feet per thousand feet).

The following table presents the selected pipe diameters and associated flow characteristics. Flows are calculated using a 10 percent safety factor. Head losses are calculated assuming a Hazen-Williams friction factor of C = 120. Due to room constraints in the Mountain View overcrossing, the pipeline diameter has been reduced in this stretch. Although the velocity will be slightly higher than desired, the distance through the bridge is short and the head loss is within acceptable ranges.

Following are the flow characteristics for the proposed collection header and pipeline.

Well Flow	Q (gpm)	Pipe Diameter (inches)	Velocity (fps)	Head Loss (ft/1000 ft)
No. 2	1,870	16	2.7	1.9
No. 5	1,870	12	4.8	7.5
No. 5 plus No. 4	3,740	16	5.5	6.8
No. 2 plus No.4 plus No. 5	5,610	24	3.7	2.0
No. 2 plus No. 4 plus No. 5	5,610	20	5.3	4.9
No. 3	2,200	16	3.2	2.5

2.3 CONNECTION AT TREATMENT PLANTS

The Waterman plant transmission pipeline will terminate at the proposed treatment plant just north of the existing treatment facilities at the Waterman Plant. The 17th Street plant transmission pipeline will terminate at the existing above ground, 14-inch-diameter, raw water header near the northwest corner of the plant.

2.4 17TH STREET PLANT BACKUP CONNECTION

To ensure an uninterrupted supply of raw water to the 17th Street water treatment plant, a connection between the 24-inch diameter pipeline and the 16-inch diameter pipeline will be made at the intersection of Mountain View Avenue and 17th Street. This connection will allow raw water to be supplied to the 16-inch pipe from the 24-inch pipe via a pressure reducing valve (PRV). This PRV, sized at 8-inch diameter, will be installed underground in a precast vault located in the sidewalk.

The PRV can be set to open and close at a preset downstream pressure. In the event Well No. 3 is out of service and the pressure downstream of the valve drops below the preset pressure, the PRV could open, allowing water to enter the 16-inch pipe from the 24-inch pipe.

The PRV, in addition to allowing water transfer between zones of differential pressures, will have a flow limiting device to maintain a steady volume of water to the 17th Street plant. It will also be back-pressure sustaining, thus maintaining the integrity of the transmission pipeline to the Waterman plant.

2.5 PIPELINE APPURTENANCES

The transmission pipelines will have shut-off (butterfly) valves installed at intervals of approximately 2,000 feet. A blow-off and a combination air valve will be installed immediately upstream and downstream of the shut-off valve respectively, allowing ease of isolation, draining and refilling of sections of the transmission pipelines. Shut-off valves will be provided at both sides of the Mountain View Avenue Overcrossing.

2.6 WELL WASTE LINES

At the beginning of each pumping cycle, the well waste lines will convey extracted groundwater to the storm drain system. As discussed earlier, the wells will be located along 11th Street. Each well will be connected to a common waste header pipeline located in 11th Street. The header pipeline will tee into another pipeline at Sierra Avenue. From that tee, the water will be conveyed to and discharged into a storm drain located at 9th Street and Sierra Way. The waste pipeline in 11th Street will be constructed in the same trench as the well collection header. Since the wells will not discharge into the pipeline simultaneously, the pipeline needs only be sized for the largest, single well which is Well No. 3 at 2,000 gpm. At 2,000 gpm in a 12-inch diameter pipeline, the velocity and head loss per thousand feet is 5.9 fps and 11.5 feet. Since this pipe does not affect the well pump sizing, higher velocities and head losses can be tolerated and a 12-inch diameter polyvinyl chloride (PVC) C900 pipe is recommended.

2.7 REGULATORY AGENCY REQUIREMENTS

Plans for the freeway crossing have been reviewed by the Caltrans District 7 Structural Group. The city of San Bernardino Public Works Department will review the design impact on city streets and drainage. The SBMWD will review the water pipeline design and testing requirements.

3.0 PIPELINE CONSTRUCTION

3.1 TRENCHING

Trench Width. Maximum trench width for the transmission pipeline shall not exceed 30 inches or 1.5 times the outer diameter (O.D.) of the pipe plus 18 inches, whichever is greater. Minimum trench width shall be the O.D. of the pipe plus 12 inches.

Trench Depth. Depths of trenches shall be as indicated on the plans, with a minimum depth to allow a minimum cover of 36 inches over the top of the pipe, unless otherwise noted.

Trench Length. The length of trench excavated in advance of pipe laying shall be kept to a minimum. All unattended trench shall be covered with approved traffic plates or fenced with an approved 5-foot high chain link fence and clearly marked and delineated.

Trenching in Paved Areas. Prior to trench excavation in pavement surfaces, straight vertical trim lines shall be cut to minimize breaking and cracking of the remaining surface.

3.2 BACKFILLING AND COMPACTION

Backfill Material. Select native material meeting the specified size and shape requirements (R value, swell pressure, sand equivalent, etc.) and free from wood waste or other extraneous or objectionable materials may be used for trench backfill material.

Pipe Bedding. Bedding material shall consist of clean, granular, well-graded screened or crushed sand and gravel or native material free of stones and conforming to the specified gradation when tested in accordance with American Society of Testing and Materials (ASTM) D422. Pipe bedding and backfill to 6 inches over the crown of the pipe shall be completed before backfilling operations are started.

Compaction Requirements. The pipe bedding zone shall be compacted to 90 percent of maximum density. The trench backfill shall be mechanically compacted to 90 percent of maximum density, except for trenches over 8-feet in depth. For trenches over 8-feet deep, backfill at depths over 4 feet may be compacted by either water settling or mechanical compaction. The top 4 feet of the trench line shall be mechanically compacted to 90 percent.

3.3 PAVING

Asphaltic Concrete. Asphaltic concrete paving mix shall comply with Caltrans Standard Specifications, Section 39, Type B. Asphalt trench patch shall match or exceed existing asphalt thickness and shall have a 6-inch minimum crushed aggregate base.

3.4 TEMPORARY CONTROLS

Construction Cleaning. The Contractor shall keep the work site and other areas in a neat and clean condition, and free from any accumulation of rubbish.

Air Pollution Control. The Contractor shall carry out effective measures wherever and as often as necessary to prevent the operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity.

Sanitary Provisions. The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees and the Engineer.

Provision for Water Courses. The Contractor shall provide for the flow of all water courses, sewers or drains, intercepted or disturbed by the Contractor during the progress of the work, and shall replace the same in as good condition as found or shall make such final provisions for them as necessary. The Contractor shall not obstruct the gutter of any street, but shall use all proper measures to provide for the free passage of surface water. The Contractor shall make provisions to take care of all surplus water, mud, silt, or other runoff pumped from excavations or resulting from sluicing or other operations, and shall be responsible for any damage, of whatever nature, resulting from failure to provide such.

Archaeological or Cultural Resources. In the event that any archaeological or cultural resources are uncovered during the course of construction, all work shall cease until an inspection and evaluation of the site has been made by an archaeologist to ensure that archaeological data are properly preserved. The Contractor shall notify the Engineer who will in turn notify the proper authorities.

Maintenance of Traffic. The Contractor shall conduct his work so as to interfere as little as possible with public travel, and shall at his own expense provide and maintain suitable bridges, detours, or other temporary facilities for the accommodation of public or private travel including mail delivery, and shall give reasonable notice to the owners of private drives before interfering with them.

Noise Control. Unless otherwise authorized by the Engineer, construction operations shall be restricted to the hours between 7:00 a.m. and 7:00 p.m.

3.5 TESTING

Compaction Testing. Quality control monitoring of subgrade backfill and embankment materials and construction shall be performed by a certified independent laboratory. In-place density testing shall be in accordance with ASTM D1556 or ASTM D2922. The moisture density standards shall be ASTM D1557 or ASTM D3017.

Pressure Testing. Hydrostatic pressure test and leakage test shall conform to American Water Wroks Association (AWWA) C600 requirements as modified herein. Hydrostatic pressure test shall consist of maintaining a pressure of 225 pounds per square inch (psi) continuously for a period of at least 2 hours. The leakage rate for pipe shall not exceed 10 gallons per inch, is in diameter per mile of pipe per 24 hours.

Measurement of leakage shall be by the positive displacement measurement of water pumped out of an open container after the pipeline test pressure has been obtained and stabilized, or through the use of a city-supplied meter.

Disinfection and Bacteriological Tests. Final flushing, disinfecting, and bacteriological tests of water pipes shall conform to AWWA C651 guidelines. City personnel will perform water sampling and bacteriological testing.

4.0 TECHNICAL SPECIFICATIONS

The following sections are included in the technical specifications. Full technical specifications are included under a separate cover.

DIVISION 1

01001	Specification Structures
01010	Summary of Work
01028	Change Order Procedure
01041	Project Coordination
01043	Job Site Administration
01050	Field Engineering
01070	Abbreviations and Symbols
01090	Reference Standards
01210	Preconstruction Conferences
01220	Progress Meetings
01310	Construction Schedules
01410	Testing Laboratory Services
01420	Inspection Services
01515	Temporary Water
01545	Protection of Work and Property
01560	Temporary Controls
01590	Field Offices and Sheds
01650	Testing, Start-Up, and Operation
01700	Contract Close Out
01710	Final Cleaning
01720	Project Record Documents

DIVISION 2

02010	Subsurface Investigation
02110	Site Clearing
02222	Excavating, Backfilling, and Compacting for Utilities
02510	Asphaltic Concrete Paving
02575	Pavement Repair and Resurfacing
02576	Asphalt/Concrete Paving Removal
02610	Pipe and Fittings
02640	Valves
02660	Water Lines
02760	Existing Utilities/Facilities Underground and Overhead
02980	Landscape Restoration

DIVISION 3

03300	Cast-In-Place Concrete

5.0 DETAILED DRAWINGS

Detailed drawings are provided in a separate package for the transmission pipeline from 11th Street to the Waterman Plant and to the 17th Street Plant, well pump discharge header and well waste pipeline in 11th Street, well waste line in Sierra Way between 9th and 11th Streets, and the Mountain View overcrossing.

Drawing No.	Sheet Title
00	Cover Sheet
01	Location Maps and General Notes
02	Index, Legend, and Abbreviations
03	Plan and Profile, Sierra Way STA 10+00 to STA 22+00
04	Plan and Profile, 11th Street STA 10+00 to STA 22+00
05	Plan and Profile, 11th Street STA 20+00 to STA 28+00 and Mountain View Avenue STA 6+00 to STA 9+00
06	Plan and Profile, 11th Street STA 28+00 to STA 37+00 and Sierra Way STA 22+00 to STA 24+00
07	Plan and Profile, 11th Street STA 37+00 to STA 43+47
08	Plan and Profile, Mountain View Avenue STA 9+00 to STA 21+00
09	Plan and Profile, Mountain View Avenue STA 21+00 to STA 32+00
10	Plan and Profile, Mountain View Avenue STA 32+00 to STA 44+00
11	Plan and Profile, Mountain View Avenue STA 44+00 to STA 56+00
12	Plan and Profile, Mountain View Avenue STA 56+00 to STA 68+00
13	Plan and Profile, Mountain View Avenue STA 68+00 to STA 80+00
14	Plan and Profile, Mountain View Avenue STA 80+00 to STA 92+00
15	Plan and Profile, Mountain View Avenue STA 92+00 to STA 104+00
16	Plan and Profile, Mountain View Avenue STA 104+00 to STA 115+16
17	Plan and Profile, Marshall Blvd. STA 10+00 to STA 18+00
18	Plan and Profile, Marshall Blvd. STA 18+00 to STA 29+52
19	Plan and Profile, Leroy Street STA 10+00 to STA 5+96
21	Plan and Profile, 17th Street STA 10+14 to STA 15+07
22	Miscellaneous Details
23	Miscellaneous Details
24	Mountain View Avenue Overcrossing Details
25	Mountain View Avenue Overcrossing Details

6.0 CONSTRUCTION COST ESTIMATE

Table 6.1

PIPELINE COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Engineer's Estimate	
				Unit Price	Total
1	Mobilization	LS	1	$60,985.00	$81,261.00
2	Connection to Existing System	EA	3	$3,500.00	$10,500.00
3	Connection to Extraction Well Piping	EA	10	$1,500.00	$15,000.00
4	12-Inch polyvinyl chloride (PVC) Pipe	LF	4317	$35.00	$151,095.00
5	12-Inch DIP	LF	1492	$45.00	$67,140.00
6	16-Inch DIP	LF	6285	$60.00	$377,100.00
7	24-Inch DIP	LF	13432	$90.00	$1,208,880.00
8	16-Inch Butterfly Valve	EA	1	$2,500.00	$2,500.00
9	24-Inch Butterfly Valve	EA	7	$4,000.00	$28,000.00
10	Combination Air Valve Assembly	EA	10	$2,500.00	$25,000.00
11	Blowoff Assembly	EA	12	$2,500.00	$30,000.00
12	Install PRV Station	EA	1	$25,000.00	$25,000.00
13	Soils Compaction Testing	LS	1	$27,000.00	$27,000.00
	Construction Cost				$2,028,200.00
	Contingency @ 10%				$202,820.00
	Total Construction Cost				$2,231,020.00

Abbreviations:
LS Lump sum
EA Each
LF Lineal feet
DIP Ductile iron pipe

Note: PVC pipe and DIP installed, complete, including pipe materials, fittings, excavation, bedding, fill material, export of unsuitable material, pavement repair, restoration of property, and all necessary work for a complete product.

Table 6.2

MOUNTAIN VIEW OVER CROSSING
PIPELINE PENETRATION

Item No.	Description	Unit	Estimated Quantity	Engineer's Estimate	
				Unit Price	Total
1	Mobilization/Demobilzation	LS	1	$19,158.00	$19,158.00
2	Traffic Controls ($50/ft)	LF	300	$50.00	$15,000.00
3	Pavement Removal (2 @ 50'x30')	SF	3,000	$3.00	$9,000.00
4	Entrance/Exit Pits	CY	1,100	$5.00	$5,500.00
5	Deck Openings (4 @ 6'x3')	SF	72	$90.00	$6,480.00
6	Bridge Falsework (exist.) Removal	C.F.	11,650	$4.00	$46,600.00
7	Concrete Coring	EA	5	$2,000.00	$10,000.00
8	Pipe Supports	EA	24	$450.00	$10,800.00
9	Reinforce Structure	CY	6	$1,800.00	$10,800.00
10	30" Steel Casing	LF	290	$90.00	$26,100.00
11	20" DIP	LF	380	$60.00	$22,800.00
12	Patch Deck (4@ 6'x3')	EA	4	$2,500.00	$10,000.00
13	Backfill & Compact Pits	CY	1,100	$5.00	$5,500.00
14	Pavement Replacement	SF	3,000	$4.00	$12,000.00
15	Debris Removal/Disposal	CY	100	$10.00	$1,000.00
Construction Cost					$210,738.00
Contingency @ 10%					$21,074.00
Total Construction Cost					$231,812.00

Abbreviations:

LS	Lump sum	LF	Lineal Feet
EA	Each	SF	Square feet
CY	Cubic yard	CF	Cubic foot

7.0 OPERATION AND MAINTENANCE MANUAL

The Operation and Maintenance (O&M) manual will provide information on O&M of the transmission pipeline and connected equipment. The O&M manual will include pipeline description, valve schedule, and maintenance schedule. Because a majority of this information comes from the equipment supplier upon delivery, an O&M manual has not been developed at this time. Following final selection of system components, and prior to system operation, a draft O&M manual will be prepared. The probable outline for this document is presented below.

1.0 Introduction and Project Description

2.0 Components
- 2.1 Pipe
- 2.2 Valves

3.0 Operating Procedures
- 3.1 Initial Filling and Testing
- 3.2 Routine Maintenance
- 3.2.1 Valve exercise program
- 3.2.2 Flushing
- 3.2.3 Repair servicing

Appendices:
Equipment Specifications and O&M Manuals

8.0 BIBLIOGRAPHY

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